

## 1 CLAIMS

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3 1. Apparatus for mobilising drill cuttings in a  
4 well, comprising at least one vane, and two or more  
5 blades defining at least one fluid conduit between  
6 adjacent blades, the blades and vane being rotatable  
7 relative to one another.

8

9 2. Apparatus according to claim 1, wherein the  
10 blades are configured to create a pressure  
11 difference in a fluid flowing through the at least  
12 one fluid conduit.

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14 3. Apparatus according to claim 1 or claim 2,  
15 comprising a sleeve adapted to fit over a drill  
16 string in the well.

17

18 4. Apparatus according to claim 3, wherein the or  
19 each vane is provided on the sleeve.

20

21 5. Apparatus according to any preceding claim,  
22 wherein the blades project radially outward to a  
23 greater extent than the or each vane.

24

25 6. Apparatus according to any of claims 3 to 5,  
26 wherein the blades are mounted on a bushing that is  
27 rotatably mounted on the sleeve.

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29 7. Apparatus according to any of claims 3 to 6,  
30 wherein the blades are arranged substantially  
31 parallel to an axis of rotation of the sleeve.

32

1     8.    Apparatus according to claim 6, wherein the  
2     blades are offset with respect to an axis of  
3     rotation of the bushing such that the blades extend  
4     helically around the bushing.

5

6     9.    Apparatus according to claim 8, wherein the  
7     blades are offset at an angle of 3-10° with respect  
8     to the axis of rotation.

9

10    10.   Apparatus according to any of claims 3 to 9,  
11    comprising fixing means for attaching the sleeve to  
12    the drill string.

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14    11.   Apparatus according to claim 10, wherein the  
15    fixing means comprises a clamp means.

16

17    12.   Apparatus according to claim 11, wherein the  
18    clamp means comprise an annular clamp.

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20    13.   Apparatus according to any preceding claim,  
21    wherein the or each vane is rotationally fixed to a  
22    drill string such that rotation of the drill string  
23    causes rotation of the or each vane.

24

25    14.   Apparatus according to any preceding claim,  
26    wherein the or each vane is configured to create  
27    thrust when rotated in a fluid.

28

29    15.   Apparatus according to any preceding claim,  
30    wherein the blades have an asymmetric profile.

31

1     16. Apparatus according to any preceding claim,  
2     wherein the blades are shaped in the form of foils,  
3     so that the fluid conduits defined between adjacent  
4     blades on the bushing change in profile.

5

6     17. Apparatus according to any preceding claim,  
7     wherein the at least one fluid conduit is relatively  
8     narrow at an end proximal to a drill bit and  
9     relatively wider towards another end distal from the  
10    drill bit.

11

12    18. Apparatus according to any preceding claim,  
13    wherein a cross section through the blades is in the  
14    form of an hour glass.

15

16    19. Apparatus according to claim 18, wherein the  
17    blades are shaped to have a wide root radially inner  
18    most adjacent the bushing, a wide top at the  
19    radially outermost part of the blade arranged to  
20    bear against the borehole wall, and a narrower  
21    cutaway portion between the root and top.

22

23    20. Apparatus according to any of claims 6 to 18,  
24    wherein the bushing is formed from a rigid material.

25

26    21. Apparatus according to any of claims 3 to 20,  
27    wherein the sleeve has an annular body to  
28    accommodate a tubular therethrough.

29

30    22. Apparatus according to claim 21, wherein the  
31    annular body has at least one vane integrally formed  
32    therewith.

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2 23. Apparatus according to a claim 21, wherein the  
3 sleeve has at least one vane-receiving recess  
4 therein to receive and retain at least one modular  
5 vane.

6

7 24. Apparatus according to any of claims 6 to 23,  
8 wherein the bushing has blades integrally formed  
9 therewith.

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11 25. Apparatus according to any of claims 6 to 23,  
12 wherein the bushing has blade-receiving recesses  
13 therein to receive and retain modular blades.

14

15 26. Apparatus according to any of claims 3 to 25,  
16 wherein the at least one vane lies parallel to the  
17 axis of rotation of the sleeve.

18

19 27. Apparatus according to any of claims 3 to 25,  
20 wherein the at least one vane is curved so as to  
21 scoop fluid from an area surrounding the vanes.

22

23 28. Apparatus according to claim 27, wherein the at  
24 least one vane is configured in a sinusoidal shape.

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26 29. Apparatus according to claim 27 or claim 28,  
27 wherein the at least one vane is offset with respect  
28 to the axis of rotation of the sleeve such that one  
29 end of the at least one vane is circumferentially  
30 spaced around the sleeve from the other end.

31

- 1     30. Apparatus according to claim 29, wherein the  
2     direction of offset of the at least one vane is in  
3     an opposite direction to the offset of the blades.  
4
- 5     31. Apparatus according to any preceding claim,  
6     wherein the at least one vane has a concave surface.  
7
- 8     32. Apparatus according to claim 31, wherein the  
9     concave surface is provided on one side of the or  
10    each vane facing the direction of rotation.  
11
- 12    33. Apparatus according to a claim 32, wherein the  
13    side of the or each vane is shaped to have a greater  
14    radius of curvature at one end than at another end.  
15
- 16    34. Apparatus according to any preceding claim,  
17    wherein the at least one vane has one or more  
18    notches cut away from a radially outermost portion  
19    thereof.  
20
- 21    35. A drill cuttings agitation assembly, comprising  
22    a tubular, at least one vane, and two or more blades  
23    defining at least one fluid conduit between adjacent  
24    blades, wherein the at least one vane and the blades  
25    are rotatable relative to one another.  
26
- 27    36. A method of agitating drill fluid in an oil or  
28    gas well, the method comprising passing the drill  
29    fluid past at least one vane rotatable relative to  
30    two or more blades.  
31

1     37. A method according to claim 36, including  
2     configuring the blades to create a pressure  
3     difference in fluid flowing through at least one  
4     fluid conduit defined by the two or more blades.

5

6     38. A method according to any of claims 36 or 37,  
7     including providing the at least one vane on a  
8     sleeve.

9

10    39. A method according to claim 38, including  
11    providing blades on a bushing and rotatably mounting  
12    the bushing with respect to the sleeve.

13

14    40. A method according to any of claims 36 to 39,  
15    including mounting and rotationally fixing the at  
16    least one vane on a drill string.

17

18    41. A method according to claim 40, including  
19    rotating the drill string to rotate the at least one  
20    vane, thereby agitating the drill fluid in the  
21    environment.

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23    42. A method according to any of claims 40 and 41,  
24    including centralising the sleeve within a bore in  
25    which the drill string is located, by means of the  
26    blades.

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